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Title: Performance Improvement of Routing Protocol in Mobile Ad-Hoc Network

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ABSTRACT

The issue of performance improvement in routing of Mobile Ad hoc Network is very challenging than other conventional wireless networks due to the mobility behavior of the participating nodes, absence of centralized routers and routing through intermediate nodes. For successful communication between a pair of source and destination it is essential that the intermediate nodes also perform well on the ground of trustworthiness, no or minimum drop-age of data packets, and consequently nodes should keep consideration on their residual battery power for the high priority operation of data transfer. The proposed research work will be based on the various ways for improving the performance of mobile ad-hoc network in different areas of its applications. Performance improvement is required in every part of mobile ad-hoc network, all mobile nodes operate on battery power; hence power consumption becomes an important issue; besides the power issue the Quality of Service (QoS) parameters such as: bandwidth, throughput, hop-count are also required for a reliable connection between participating nodes. In the research work we will put our efforts to study the problem of nodes having bandwidth constraint and will propose a strategy for Performance Improvement of Routing Protocol in Mobile Ad-Hoc Network.

Keywords: Manet, performance improvement, residual battery, power, bandwidth.

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TABLE OF CONTENTS

S.No.	Description	Page. No.
1	Introduction	4-7
2	State of art	7-11
3	Objectives	11
4	Methodology	11
5	Significance	12
6	Proposed output of the research	13
7	References	13-16

INTRODUCTION:

Emergency regulation enforcement, disaster affected search, rescue and relief are the operations which are generally performed in situations with no base stations. Although a temporary base station can be installed for the coverage of desired areas with wireless network. But this strategy is less reliable due to the probability of single point failure in such an environment. The placement of mobile ad-hoc network is the only solution for such situations. MANET permits various nodes to organize themselves into a network which leads ad-hoc network to operate even in the absence of static base station [1]. Mobile Ad-hoc Network (MANET) is a joint work of mobile nodes with a capability of transmitting and receiving data packets without any fixed infrastructure. In MANET, nodes route traffic for each other. Consequently, in a well established ad-hoc network a data packet can be transmitted from any source to destination either through some set of intermediate nodes or directly from source to destination. However, the volatility of the paths between any two nodes will be high due to mobility of nodes in the network. This is a central problem in MANET routing.

The ability of self-configuration and self-maintenance has made mobile ad-hoc network (MANET) a hot topic for research in recent developments [2-8]. Though the early research effort were paying attention on problems such as wireless channel access and multi hop routing, yet the performance improvement in MANET has become a main objective in order to provide fast, reliable, energy efficient and protected communication between the nodes. However, performance improvement was considered as an active research topic in wireless networks in past years also, but the unique characteristics of MANET present a new set of challenges to improve performance of routing protocols. These challenges include shared Wireless medium, open network architecture, highly dynamic network topology and stringent resource constraints. Accordingly, the on hand solutions for wired networks cannot be directly applied to the mobile ad-hoc network. The ultimate goal of the performance improvement solutions [9-12] for MANET is to provide expansion in residual battery power, solutions for bandwidth constraints, and availability to mobile users.

The main challenge with ad-hoc network is the process of sending a message from one node to another without any direct link. As the nodes in the network change their position

continuously and it is very difficult to know that which nodes are directly linked together. The constantly position changing behavior of nodes leads to a change in the topology of network and which is a very difficult task for a routing process. Various routing protocols are available at present; some of them are taken here for discussion purpose.

Types of MANET Routing Protocols:

On the basis of working behavior, route information storing process, quality of service (QoS), and battery power a number of routing protocols [13-18] are available in now days, we are taking a few protocols here for discussion purpose.

A. Proactive/Table-Driven Routing Protocols:

The nodes of proactive routing protocol, maintains pre-information about the route of every other node in the network. Various tables are used for storing the routing information in table driven routing protocols. These tables are updated either periodically or if the network topology changes. The way of updating route information and the type of information to be kept in each routing table creates difference between these protocols. Keeping up-to-date routes to all destinations, even if they are not used, is a disadvantage of table driven protocols, thus it leads to unnecessary utilization of bandwidth and network resources. Proactive protocols are not more suitable in situations where the frequency of topology change is more. Consequently the proactive approach is more suitable for a low mobility network. The various proactive routing protocols are being discussed as below.

i). Destination-Sequenced-Distance-Vector Routing*:* DSDV is the table driven routing protocol. It is based on classical Bellman-ford routing mechanism. In this category of routing protocol each node in the network maintains routing table, which contain all of the likely destinations within the network and the number of hops to each destination. The formation of looping is stopped by assigning a sequence number by the destination node for each entry into the table. In order to maintain consistency routing table [19-24] updates are periodically transmitted. In DSDV the control overhead is directly proportionate to the number of nodes in the network and it is a major drawback for this protocol. Secondly, in order to obtain information about a particular node, the concern

node has to wait each time for a table update message, which is again not a good practice for an ideal routing protocol.

ii). Cluster Head Gateway Switch Routing Protocol: This routing protocol uses hierarchical network topology. The nodes of the network are organized into small clusters [25-31]. A cluster head also called as coordinator for each cluster will be responsible for coordinating among members of each cluster. The issues like channel access, bandwidth allocation are also handle by cluster heads. The better bandwidth [32-36] consumption is the main advantage of this protocol. The disadvantage of this routing protocol is the situations where frequent cluster head changes occur and which badly affect routing performance. This also degrades the overall performance as the system is busy in cluster head selection rather than data transmission. Another disadvantage is the power consumption, which occurs more at the cluster-head as compared to other nodes.

B. Reactive/On-Demand Routing Protocols:

These protocols were designed to overcome the wasted effort in maintaining unused routes. It is of the general view that routing information is required only when there is a need for it, thus the route information should be retrieved only for those routes which are in demand. This approach later on helps in saving the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase. It is obvious that a long delay can arise before data transmission because it has to wait until a route to the destination is acquired. Reactive routing protocols are not optimal in terms of bandwidth utilization, as these protocols flood route request packet into the network to discover the route. But these protocols are good enough in the frequent change in network topology. Thus this strategy is suitable for high mobility [32] networks.

i). The Ad-hoc On Demand Distance Vector routing protocol (AODV): AODV routing algorithm is designed for ad-hoc mobile networks. Both unicast and multicast routing operations can be performed by this protocol. AODV builds routes between nodes only on the demand of source nodes. These routes stay as long as they are needed by source node. AODV uses sequence numbers to ensure the freshness of routes. It is a loop-free, self-starting routing protocol same time it scales to large number of mobile nodes [5].

When there exist a requirement of route from source to destination node, it sends a route request (RREQ) packet to all nodes in the network [6]. After receiving RREQ packet, nodes update their information for the source node and set up backwards pointers to the source node in the route table. The route request (RREQ) packet contains the source node's IP address, current sequence number, broadcast ID and the most recent sequence number for the destination. A node may send a route reply (RREP) message after receiving the RREQ if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the route request message (RREQ). In the due course nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it.

C. Hybrid Routing:

When the selected features of reactive and proactive routing protocols are combined together, the resulting protocol is called as Hybrid protocol. It takes advantages of these two protocols and as a result, routes are found very fast in the routing zone. The below mention protocol is the one type of various hybrid routing protocols.

i). Zone Routing Protocol (ZRP)*:* ZRP routing protocol is a type of Hybrid Routing protocols. It combines the best features of reactive and proactive routing protocol. The key concept is to use a proactive routing [35-36] scheme within a limited zone in the r-hop neighborhood of every node, and use reactive routing scheme for nodes beyond this zone.

STATE-OF-ART:

- The principle behind ad-hoc networking is multi-hop relaying, which traces its roots back to 500 B.C. (522-486 B.C.), the king of perisa, used to send messages from capital to remote of his empire by means of a line of shouting men positioned on tall structures or heights .
- In 1970, Norman Abramson and his fellow researchers at the University of Hawaii invented the ALOHAnet, an innovative communication system for linking together the universities of the Hawaiian Islands.

- In 1994, the Swedish communication equipment maker Ericsson proposed to develop a short-range, low-power, low-complexity and inexpensive radio interface and associated communication protocol referred to as *Bluetooth* for heterogeneous devices.

Research on security in MANET has emerged during recent years. A Service Discovery Protocol proposed by "Yuan Yuan, Ashok Agrawala," divides the task in two phases with their purposes as follow:

- **Service Discovery Phase**: In this phase each node will maintain a small size cache to keep the present valid service descriptions and behave as a delegate of the service to response service request.
- **Security Phase:** It requires a service provider maintain a dynamic transaction history list, which stores the transaction results for the active nodes it served before. The item in the list should be composed of {(Client Node Identity), (HMAC (Receipt, QoS)}, which server generates receipt, HMAC is hash code using the private key of client and QoS field is the description of quality of the service.

The work proposed by "Yuan Yuan, Ashok Agrawala," has been extended by "H Yang et al." in the form of multifence solution, which again comprises two phases as discussed below:

- **Secure Ad-hoc Routing:** The secure ad-hoc routing takes the proactive approach and enhance the existing ad-hoc routing protocols, such as DSR and AODV, with security extensions. In these protocols, each mobile node proactively signs its routing messages using the cryptographic authentication primitives
- **Secure Packet Forwarding:** In this phase a reactive approach is taken because attacks on packet forwarding cannot be prevented: an attacker may simply drop all packets passing through it, even though the packets are carefully signed. At the heart of the reactive solutions are a detection technique and a reaction scheme
- The work proposed by "Yih-Chun Hu, Adrian Perrig, and David B. Johnson" gives a protocol named **TESLA with instant key disclosure** that provides MANET a security against worm hole. An attacker records packet at one location of the network, tunnel them to another location, and retransmits them there into

the network. The problem has been solved by adding information into the packet to restrict its maximum allowed transmission distance

- The work proposed by Sonja Buchegger (IBM ZRL-Switzerland), Jean-Yves Le Boudec" describes about a **CONFIDANT** protocol which continuously monitor nodes and prepares a table based on the rating given to the node by the other neighboring nodes in the network if the resulting rating is intolerable, trigger the Path manager which deletes all routes containing the intolerable node.

In addition to the study of MANET history, we also have undergone to the various periodicals based on the routing protocols which can be discussed as below.

- Abusalah, L (2008), in this paper, he reviewed AODV, DSR, OLSR and TORA protocols with a particular focus on security aspects. Secure ad hoc networks have to meet five security requirements: confidentiality, integrity, authentication, non-repudiation and availability. The analyses of the secure versions of the proposed protocols are discussed with respect to the above security requirements.

- Lima, M.; dos Santos, A.; Pujolle, G (2009) this article examines survivable approaches whose goal is to enable networks to fulfill their critical functions correctly even in the presence of attacks or intrusions. Author introduced the most relevant survivable MANET initiatives where either preventive or reactive defenses are combined with tolerant ones. And they classify the defense lines taking into account intrusion tolerance mechanisms and also identify properties and requirements of survivability.

- Chunhung Richard Lin; Jain-Shing Liu (1999), the authors of this paper propose a bandwidth routing protocol for quality-of-service (QoS) support in a multi-hop mobile network. The QoS routing feature is important for a mobile network to interconnect wired networks with QoS support (e.g., ATM, Internet, etc.).

- Kannan, T.; Pushpavalli (2010), in this paper authors have discussed various challenges due to bandwidth constraint and dynamic topology of the mobile ad-hoc networks supporting quality of service (QoS). The aim of this work is to present QoS

enabled routing protocol in ad-hoc networks and compare it with normal routing protocol.

- Sungwon Kim; Chul-Ho Lee (2010), in this paper, authors have investigate numerous GPS mobility traces of human mobile nodes and observe super diffusive behavior in all GPS traces, which is characterized by a faster growth rate of the mean square displacement (MSD) of a mobile node. They then investigate a large amount of access point (AP) based traces, and develop a theoretical framework built upon continuous time random walk (CTRW) formalism, in which one can identify the degree of diffusive behavior of mobile nodes even under possibly heavy-tailed pause time distribution, as in the case of reality.

- Nitnaware, D.; Karma, P.; Verma, A. (2009), this paper is a proposal of a new algorithm called ECG_AODV (Energy Constraint Gossip based) routing protocol and analyzes its behavior under stochastic traffic. In the present paper authors want to analyze its behavior under stochastic traffic (Pareto traffic) and compare the same with CBR traffic. The protocol works on current energy status of each node and Gossip technique.

- Garcia-Luna-Aceves, J.J.; Sampath, D. (2009), in this paper authors present AIR (automatic incremental routing), a unified approach for scalable unicast and multicast routing in mobile ad hoc networks (MANET). In AIR, nodes run a distributed routing algorithm to assign prefix labels to themselves. The labels are assigned such that routing to unicast or multicast destinations is automatic.

- Madan, R.; Mehta, N.B.; Molisch, A.F.; Jin Zhang (2009), in this paper the authors have considered the problem of computing an energy-optimal cooperative transmission scheme in a wireless network for two different channel fading models: (i) slow fading channels, where the channel gains of the links remain the same for a large number of transmissions, and (ii) fast fading channels, where the channel gains of the links change quickly from one transmission to another.

From the above discussion we can conclude to the below mentioned gist.

- MANET networks are characterized by a lack of infrastructure, and by a random and quickly changing network topology: thus the call for *a strong dynamic routing protocol* that can accommodate in such an environment is being required.
- MANET has become an important edge network to provide urgent situation access to remote areas and in a metropolitan scale. These applications require Quality of Service (QoS) parameters such as: bandwidth, throughput, hop-count and energy to be adequate so that a reliable connection between participating nodes may be maintained. The nodes in these networks have several constraints such as transmission power, bandwidth and processing capability. In addition to it an important parameter of interest is the residual battery power of the nodes. Conventional routing schemes do not take this aspect into consideration. Therefore *a routing strategy that takes this aspect into consideration* is required to enhance the efficiency of MANET routing and network life time.

OBJECTIVES:

- To study various categories of routing protocols on the basis of various performance metrics.
- To analyse these categories of routing and provide an outcome as to which routing protocol is better.
- To study and analyse various issues in MANET such as residual battery power, bandwidth and environmental conditions on performance of routing protocols.
- To propose a routing strategy that considers residual battery and priority of the packet as a route metric to construct a route from source to destination.
- To implement the proposed routing strategy in QualNet and analyse the impact of same on performance metrics.

METHODOLOGY:

Phase 1: Study of recent research work in MANET routing and related areas.

Phase 2: Comparing the performance of existing protocols using simulator.

Phase 3: Proposal and design of new strategy for MANET using simulator.

Phase 4: Comparison of existing protocols and proposed strategy on the basis of various factors affecting the performance of MANET and later displaying the results.

SIGNIFICANCE:

The enormous use of mobile ad-hoc network requires a continuous improvement in the various fields of MANET. At present there exist many issues which degrade the performance of MANET. The following are some challenges which require further improvement.

- **Bandwidth restriction:** The capacity of the wireless links is always much lower than in the wired counterparts. Indeed, several Gbps are available for wired LAN, while, nowadays, the commercial applications for wireless LANs work typically around 2 Mbps.
- **Energy constraints:** The power of the batteries is limited in all the devices, which does not allow infinitive operation time for the nodes.
- **Security:** As there is no centralized administration so Mobile wireless networks are generally more prone to security threats as compared to fixed networks.
- **Heterogeneous network:** The mobile nodes in ad-hoc network have dissimilar radio transmission (downstream) and radio receiving (upstream) frequencies.
- **Limited radio range:** MANETs have limited radio range due to limited transmission power.
- **Dynamic topologies:** Nodes are free to arbitrarily move; i.e. network topology may change randomly and rapidly at unpredictable times.

Thus there is much need for the study of performance improvement in MANET, as discussed above there are still various areas in which improvement in one or another field of ad-hoc networking is required. Considering the wide range of possibilities we expect that our initial study on MANET routing will open up new possibilities toward better design of routing protocol.

PROPOSED OUTPUT OF THE RESEARCH:

- The performance metric values such as packet delivery ratio and reachability should decrease significantly when the number of bandwidth deficient nodes increase.
- The inclusion of obstacle i.e. the environmental conditions in the simulation region may deteriorates the performance of routing protocols.
- The performance metric values such as packet delivery ratio and reachability will decrease significantly when the number of nodes having low residual battery power increases.

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